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12a. DISTRIBUTION/AVAILABILITY STATEMENT
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13. ABSTRACT (Maximum 200 words)

We recently demonstrated an innovative new idea that permits light scattering measurements at an angle of zero degrees for the first time. The idea is based on the use of coherent beam coupling in a nonlinear, photorefractive crystal of $BaTiO_3$ to separate the scattered light from the unscattered direct beam. The present problem is to extend these ideas to (a) angular distribution measurements; (b) measurements of the phase as well as the amplitude (i.e. both real and imaginary parts) of the 0° scattering; and (c) determination of the effects of coherent scattering at 0°. We have successfully measured the angular distribution of forward light scattering from quartz fibers of radii from 15 mm to 30 mm. Data have been obtained in the angular range of 0° to 0.3° with an angular resolution of better than 0.01°. The results are in good agreement with theory. Finally, the existence of coherent scattering effects at zero degrees have been considered and analyzed theoretically. Experimental data have been obtained that confirm these coherent scattering affects in suspensions of polystyrene spheres.

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Measurements of Light Scattering by Small Particles at an Angle of Zero Degrees

FINAL REPORT

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5 Months; July 1, 1992 to November 30, 1992

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January 28, 1993

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A. STATEMENT OF THE PROBLEM STUDIED

We recently demonstrated an innovative new idea that permits light scattering measurements at an angle of zero degrees. The idea is based on the use of coherent beam coupling in a nonlinear, photorefractive crystal of $BaTiO_3$ to separate the scattered light from the unscattered direct beam. The present problem is to extend these ideas to (a) angular distribution measurements; (b) measurements of the phase as well as the amplitude (i.e. both the real and imaginary parts) of the 0° scattering; and (c) determination of the effects of coherent scattering at 0°.

B. SUMMARY OF THE MOST IMPORTANT RESULTS

The angular distribution of forward light scattering from quartz fibers of radii from 15 μm to 30 μm was successfully measured. Data have been obtained at a wavelength of 514 nm in the angular range of 0° to 0.3° with an angular resolution of better than 0.01°; this is the first time such measurements have been possible in this important angular region. The results are in good agreement with theory. See publications 1, 4, and 5 below.

The existence of coherent scattering effects at zero degrees have been considered and analyzed theoretically. Experimental data have been obtained that confirm these coherent scattering affects in suspensions of polystyrene spheres. See publication 3 below.

C. LIST OF ALL PUBLICATIONS AND TECHNICAL REPORTS

1. G. G. Padmabandu, Choonghoon Oh, and Edward S. Fry, "Measurement of Light Scattering at 0° by Micrometer-Size Quartz Fibers", Optics Letters 17, 169-171 (1992).
2. Edward S. Fry, G. G. Padmabandu, and Choonghoon Oh, "Scattering At and Near 0° by Spheres and Glass Fibers", Proceedings of the 1991 Scientific Conference on Obscuration and Aerosol Research (CRDEC-SP-036), 99-108 (1992).
3. Edward S. Fry, G. G. Padmabandu, and Choonghoon Oh, "Coherent Effects in Forward Scattering", in Ocean Optics XI, G. D. Gilbert, Editor, Proc. SPIE 1750, 170-177 (1992).
4. Edward S. Fry, G. G. Padmabandu, and Choonghoon Oh, "Angular Measurement of the Forward Light Scattering from a Quartz Fiber", submitted to the Proceedings of the 1992 CRDEC Scientific Conference on Obscuration and Aerosol Research, October, 1992.
5. Choonghoon Oh, G. G. Padmabandu, and Edward S. Fry, "Angular Distribution of the Forward Light Scattering from a Quartz Fiber", submitted to the Journal of the Optical Society of America, January, 1993.

D. LIST OF ALL PRESENTATIONS

1. Edward S. Fry, "Angular Scattering At and Near Zero Degrees," Presented at the 1992 CRDEC Scientific Conference on Obscuration and Aerosol Research, Aberdeen Proving Ground, MD, June, 1992.
2. Edward S. Fry, G. G. Padmabandu, and Choonghoon Oh, "Coherent Effects in Forward Scattering", Presented at SPIE Annual Symposium, San Diego, CA, July 19-24, 1992.
3. Choonghoon Oh, G. G. Padmabandu, and Edward S. Fry, "Angular Measurement of the Forward Light Scattering from Quartz Fibers with a Barium Titanate Crystal," Presented at Optical Society of America 1992 Annual Meeting, Albuquerque, NM, September 20-25, 1992
4. Choonghoon Oh, G. G. Padmabandu, and Edward S. Fry, "Measurement of Forward Light Scattering Using $BaTiO_3$ as a Novelty Filter," Presented at Fall 1992 Joint Meeting of the TSAPS/TSAAPT/SPS, Houston, TX, November 7-8, 1992

E. LIST OF ALL PARTICIPATING SCIENTIFIC PERSONNEL SHOWING ANY ADVANCED DEGREES EARNED BY THEM WHILE EMPLOYED ON THE PROJECT

Edward S. Fry

G. G. Padmabandu

Choonghoon Oh

Mr. Oh completed most of his thesis research during the 4 month duration of this project. He will receive his PhD in May, 1993.

F. REPORT OF INVENTIONS

None

THE VIEWS, OPINIONS, AND/OR FINDINGS CONTAINED IN THIS REPORT ARE THOSE OF THE AUTHOR AND SHOULD NOT BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION, POLICY, OR DECISION, UNLESS SO DESIGNATED BY OTHER DOCUMENTATION.